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ABSTRACT

Presented are the results of a review and evaluation of the energy curriculum materials produced by the United States Department of Energy (DOE). Major findings of the project were: (1) DOE materials are receiving only limited use because of low teacher awareness of availability; (2) when materials are used, teachers evaluate materials favorably; and (3) most evaluations of DOE materials have concentrated on teacher impressions and not the effect of the materials on students. Recommendations to improve the impact of DOE energy education programs are included. (Author/RE)

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October 1979

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NOTICE

EXECUTIVE SUMMARY

Battelle's Columbus Laboratories conducted a review and an evaluation of the energy education curriculum materials for the Education Programs Division, of the Education, Business, and Labor Affairs/Intergovernmental and Institutional Relations (EBLA/IR), U.S. Department of Energy. The specific objectives of the six-month contract were:

(1) to review and assess current projects in progress
(2) to evaluate existing curriculum materials
(3) to conduct an evaluation of DOE's energy education program.

The objectives were fulfilled through provision of technical review and guidance of eight existing programs, surveys and interviews with teacher users of materials, and examination of the total curriculum development program within the Education Programs Division.

Major findings of the study include the following:

(1) DOE energy education curriculum materials appear to have limited use in our nation's schools, apparently because significant numbers of teachers do not know the materials exist.
(2) Teacher users of DOE energy education materials generally provide a favorable evaluation of the materials in terms of relevance to students, technical and reading levels, ease of use with existing curriculum, and impact on student awareness and understanding of the present energy situation. However, a need to more actively involve students in the learning process was noted.
(3) To date, most of the evaluation of DOE energy education materials has been performed on the basis of teacher perceptions, with little attention given to changes in student skills, knowledges, and behavior as a result of exposure to the curriculum materials.

Based on the study findings, the following actions are recommended to improve the operation of the Education Programs Division:

(1) The Education Programs Division should adopt a proactive approach to dissemination of energy education curriculum materials. Methods for reaching potential users include DOE presence at conventions of teachers and administrators, and published announcements and articles on available material. Also, the Education Programs Division should develop a plan to expose preservice teachers to the materials.

(2) A comprehensive, systematic, and scientific evaluation should be conducted to assess the impact on students of DOE energy education materials currently being distributed nationally to teachers. Further, consideration should be given to including more thorough and comprehensive student impact evaluation as part of the process of developing new curriculum packages. In addition, a procedure should be developed to obtain feedback on how many teachers used distributed materials, how many students are reached, and other items of interest.

(3) Based on the Education Program Division's missions, goals, and objectives, along with its determined information needs, plans and guidelines should be developed to assist the Division in determining curriculum materials that are yet needed, in evaluating unsolicited proposals, in systematically disseminating existing materials, and in evaluating curriculum materials.

(4) The Division should increase its staff to more effectively carry out instructional design, materials dissemination, and educational services.

ACKNOWLEDGMENTS

Much of the research for this project was conducted on-site at the Education Programs Division. As principal investigator for the project, Dr. Miller wishes to acknowledge the help and support of several individuals who helped in implementing the various facets of the project. These individuals are:

- Mr. Donald Duggan, Chief of Academic Programs Branch
- Mr. John Ortman, Education Programs Division
- Dr. Chris Kjeldsen, Education Programs Division
- Dr. John Fowler, National Science Teachers Association
- Dr. Helenmarie Hofman, National Science Teachers Association.

The above individuals also helped to make the six month on-site assignment in Washington, D.C., both pleasurable and rewarding for Dr. Miller.

TABLE OF CONTENTS

	Page
INTRODUCTION	1
I. REVIEW AND ASSESSMENT OF CURRENT PROJECTS	3
Consultation With Project Directors	3
On-Site Visitation	6
Telephone Consultations	6
On-Going Work	7
II. EVALUATION OF EXISTING MATERIALS	8
Methodology	8
Questionnaire Survey Results	10
Summary of Teachers' Interviews	39
III. PROGRAM EVALUATION	41
Communication Between Program Developers and DOE Staff	41
Adequacy of the Publicity and Dissemination Procedures Utilized	42
Requirements, Processes, and Guidelines Used to Determine Informational Needs of the Educational Community and the General Public	43
IV. CONCLUSIONS AND RECOMMENDATIONS	45
Extent of Use	45
User Evaluation and Perceived Needs	46
Evaluation Procedures	47
DOE Operation	48

APPENDIX A

TEACHER SURVEY INSTRUMENT	A-1

LIST OF TABLES

Table 1. Volume of DOE Energy Education Materials Disseminated	11
Table 2. Extent of Use and Use Rates of Energy Education Curriculum Materials	12

TABLE OF CONTENTS (Cont.)

Page

LIST OF TABLES (Cont.)

Table 3. Reported Reasons for not Using Materials in the Classroom (Item 7) 15

Table 4. Packets Used by Users of Oak Ridge Developed Materials (Item 8) 17

Table 5. Packets Used by Users of NSTA Developed Materials (Item 8) 18

Table 6. Packets Used by Users of Both Oak Ridge and NSTA Developed Materials (Item 8) 19

Table 7. User Evaluation of Student Interest Level and Relation of Materials to Students' Experience and Background . . . 20

Table 8. User Evaluation of Relevance of Materials 22

Table 9. User Evaluation of Achievement of Learning Objectives and Impact of Materials. 23

Table 10. User Evaluation of Appropriateness of Reading Level and Technical Level of Materials 24

Table 11. User Evaluation of Extent to Which Materials Fit into Units or Subject Matter Taught, and Constraints and Limitations in Use of Materials. 26

Table 12. User Evaluation of Likelihood of School Purchasing Energy Education Materials (Item 27) 27

Table 13. Sources Where Users Learned of the Availability of Materials (Item 21). 29

Table 14. Perceived User Needs: Additional Media and Learning Activities. 30

Table 15. Perceived User Needs: Additional Packets That Should be Developed or Additional Topics Covered (Item 24) (Users of Oak Ridge Materials) 32

Table 16. Perceived User Needs: Additional Packets That Should be Developed or Additional Topics Covered (Item 24) (Users of NSTA Developed Materials). 33

Table 17. Perceived User Needs: Additional Packets That Should be Developed or Additional Topics Covered (Item 24) (Users of Both Oak Ridge and NSTA Developed Materials) 34

Table 18. Perceived User Needs: Additional Packets That Should be Developed or Additional Topics Covered (Item 24) (Combined Results from all Three Samples). 35

INTRODUCTION

Battelle's Columbus Laboratories conducted a review and an evaluation of energy education curriculum materials for the Education Programs Division, of the Education, Business, and Labor Affairs/ Intergovernmental and Institutional Relations (EBLA/IR), U.S. Department of Energy. The specific objectives of the six-month contract were:

(1) To review and assess current projects in progress

(2) To evaluate existing curriculum materials

(3) To conduct evaluation of DOE's energy education program.

Fulfillment of objective one involved the provision of technical review and guidance for eight programs in progress. Much of the guidance was provided through discussions with the various project directors who periodically made visits to the Education Programs Division Office.

Guidance was also provided through on-site visitations and telephone consultations.

Evaluation of existing curriculum materials (objective two) was accomplished mainly through questionnaire surveys of teacher users of the curriculum materials, supplemented by interviews with teachers and by perceptions of Battelle researchers. The surveys also obtained information on the extent of use of the materials in our nation's schools.

Accomplishment of objective three (program evaluation) involved an examination of the total curriculum development program within the Education Programs Division. Particular facets examined included communication between program developers and DOE staff, adequacy of publicity and dissemination procedures utilized, and requirements, processes, and guidelines used to determine informational needs of the educational community and the general public.

Results from accomplishment of the above objectives are presented in the next three sections of this report. The last section of the report presents conclusions and recommendations.

I. REVIEW AND ASSESSMENT OF CURRENT PROJECTS

Review and assessment of DOE energy education materials and programs as well as technical guidance to curriculum developers was provided by Dr. Janet L. Miller, who worked on-site in the Education Programs Division for six months. During this time, Dr. Miller became familiar with the variety of programs already developed for the Division as well as with program developments in progress.

Technical review and guidance were provided for the following programs in progress:

1. Solar Curriculum, K-6 -- University of Southern California
2. Easy Energy Reader, 7-12 -- Information Planning Associates
3. Ten Interdisciplinary Units -- National Science Teachers Association
4. Four Disciplinary Units -- National Science Teachers Association
5. Electric Power Generation: Current and Future Resources, 11-14 -- Pennsylvania Department of Education
6. Vocational Education Curriculum -- American Association for Vocational Instructional Materials
7. Energy Conservation: Education Programs for Schools -- Energy Education Programs, Inc.
8. Energy Education Workshop Handbook -- National Science Teachers Association.

Consultation With Project Directors

Much of the guidance was provided through discussion with the various project directors who periodically made personal visits to the Education Programs Division Office. Such visitations included:

(1) Information Planning Associates -- "Easy Energy Reader, 7-12". In discussion with the project director, the on-site researcher raised the issue of readability level of several of the articles included

in the Reader. Discussion centered around the appropriate reading level for the target audience as well as the need for an introduction to the Reader. It was suggested that the introduction specify various ways in which the Reader might be utilized as an interdisciplinary tool within the classroom. Also, using the Reader within the context of English/Language Arts was stressed, given the relative lack of energy education materials which may be utilized within the humanities areas.

(2) American Association for Vocational Instructional Materials -- "Vocational Education Curriculum". In discussion with representatives from AAVIM, the on-site researcher raised the issue of separate introductions for the three segments of the manuscript, which include curriculum for use in vocational/technical high school, post secondary school, and adult education classes. Because much of the material is similar in terms of supplying conservation principles in theory and in building techniques for each of the three segments, a unique introductory segment was recommended for each of the three target audiences. Further, suggestions included:

- Constructing a revised posttest which measures informational as well as application learning
- Providing more information in the teacher's guide with regard to specific exercises. Directions for the exercises could supply the instructor with more ideas on classroom activities, on related resources, and on classroom follow-up and reinforcement
- Providing only the correct answers in the teacher's guide; there is no need to duplicate the student questions.

(3) Energy Education Programs, Inc., "Energy Conservation Education Programs for Schools". In discussion with representatives from Energy Education Programs, Inc., the on-site researcher stressed the importance of teacher involvement and commitment to the proposed program. The total program addressed the complex task of providing energy conservation implementation strategies to three levels of school administrators, including elementary, secondary, and post secondary. At the same time the total program discusses these strategies within the contexts of curriculum and extra curricular activities, transportation systems, and building facilities. Thus, because the program is directed at three separate administrative levels and contains three separate areas of concern, the discussion

centered around ways of emphasizing the importance of teacher support and involvement to insure proper implementation of the total plan. Suggestions focused upon teacher in-service programs in which the basic energy conservation implementation strategies could be presented. Methods of implementing the strategies within the three targeted areas then could be created with teacher input and support.

Also, because much of the content was identical for each of the three segments, a suggestion was made for condensation, with a three-pronged introduction serving to distinguish the three target audiences. In addition, the general implementation plan is the same in the elementary and secondary sections but needed modification in the post secondary package.

(4) N.S.T.A., "Energy Education Workshop Handbook". The Workshop Handbook is intended as a supplementary teacher's in-service guide for implementing the variety of materials developed for DOE by N.S.T.A. The majority of these materials have been prepared for a series of instructional units for grades K-12 entitled "Interdisciplinary Student/Teacher Materials on Energy, the Environment, and the Economy".

A number of suggestions were made for revisions within the Handbook, including a reordering of the sequence of planned pilot activities for the teachers to follow in implementing the actual lessons, and a reordering of materials which had been placed in the appendices. The on-site researcher raised questions about the proper sequencing of planned activities, especially, and much discussion centered around the actual restructuring of the Handbook so as to provide maximum aid for teachers in the workshop/in-service setting.

These suggested revisions are being incorporated in the reworked Handbook, now in progress.

(5) N.S.T.A., "Ten Interdisciplinary Units" and "Four Disciplinary Units". Over the six-month on-site assignment in Washington, D.C., the on-site researcher developed a close working relationship with the N.S.T.A. staff, and spent many hours in consultation with the staff. The on-site researcher offered technical guidance on a variety of developmental issues on both projects. Because N.S.T.A. is the Education Programs Division's major contractor, much time was spent in reviewing the content and format of the materials under development by N.S.T.A. as well as in discussion and collaboration. This review and technical support of N.S.T.A. materials

constituted a major portion of the on-site researcher's work. Because the basic format of the N.S.T.A.-developed materials has been constant since the initiation of the DOE/N.S.T.A. contract in 1975, the on-site researcher concentrated upon the following areas in the materials development:

(a) More variety and "hands-on" involvement of students in learning and reinforcing activities

(b) Exploration of media/visual enrichments (posters, slides, murals, etc.) for the basic materials

(c) A consideration of developing some materials which could be utilized within the disciplines of the humanities.

On-Site Visitation

The on-site researcher made an on-site visitation to the project director, University of Southern California, Los Angeles, to discuss the progress of the project "Solar Curriculum, K-6". The researcher emphasized the necessity of development of materials for grades 4-6, especially, since much of the previous materials development has centered on the early primary grades. Materials, including lesson plans as well as filmstrips, were reviewed and approved. The researcher was impressed especially with the dedication and enthusiasm demonstrated by the project director and his colleagues working on the project.

Telephone Consultations

The on-site researcher also contacted some major contractors by telephone to determine the progress of materials project development. These contacts included the Pennsylvania Department of Education, "Electric Power Generation: Current and Future Resources 11-14". The researcher informed the project director of the contract deadline and assisted in the application for a time extension to the existing contract.

On-Going Work

In addition to the previously mentioned activities, the on-site researcher maintained telephone and mail contacts with the various project directors, assisted in the review of unsolicited proposals, and was involved to some extent in the daily activities in the Education Programs Division.

II. EVALUATION OF EXISTING MATERIALS

Methodology

As previously indicated, one of the objectives of the present research effort was to evaluate existing curriculum materials. This evaluation included assessment of extent of use of the materials in our nation's schools.

No other research studies were identified dealing with actual extent of use of the materials in our schools. However, one other study was identified concerning recommended usage of energy education materials. This study, conducted by the Education Commission of the States (ECS)*, showed that materials developed under the auspices of DOE were recommended by more SEA's than any other materials. The most frequently recommended program was the National Science Teachers Association Project for an Energy-Enriched Curriculum (PEEC), developed by NSTA.

In the research reported herein, a principal means for evaluating existing curriculum materials was to contact teachers in order to assess extent of use of the materials in their classrooms, and, for teachers using the materials, to obtain their perceptions of the materials. Toward this end, a survey instrument was developed to collect the required data. The specific data needs which formed the basis for the instrument were jointly determined by personnel from the Education Programs Division and Battelle researchers. These data needs included:

- Extent to which the materials are being used, and details surrounding their use or non-use.
- Perceived needs in energy education materials, i.e., subject areas, media usage, learning activities.
- Extent to which the materials fit into existing programs and classes.
- Perceived need for training to use the materials.

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* "The Status of State Energy Education Policy", Education Commission of the States, Denver, Colorado, March 1972. Report No. 122.

- Relevance of the materials to students' experience and background and their geographic area.
- Appropriateness of the materials to students' technical level and reading level.
- Perceived impact of the materials on students' awareness and understanding of the energy situation.
- Willingness to pay for currently free materials.

The survey instrument developed is attached as Appendix A.

The data were collected in two separate efforts. First, Battelle researchers attended the 1979 National Science Teacher Association Convention to survey a sample of attendees. The researchers were situated in a prominent location and asked convention attendees to complete the questionnaire form. In addition, persons identified as having used the materials in question were interviewed at the convention, to obtain perceptions of strengths and weaknesses and general experiences with the materials.

Data were also collected in a survey conducted under the auspices of the National Science Teachers' Association. Names of teachers were obtained from two sources. Two thousand randomly selected names from the National Registry of Teachers were obtained. This group of two thousand consisted of secondary level science, social science, and mathematics teachers. They received a questionnaire essentially identical to that used at the Convention, and were asked to respond regarding NSTA-developed materials.

A second group surveyed was 600 teachers who had ordered Oak Ridge Associated University Curriculum materials. This group received the questionnaire, and were asked to respond regarding the Oak Ridge-developed materials.

Results of these survey efforts are summarized in the following sections. Questionnaire results are presented first, including all three sources of questionnaire returns (NSTA Convention, National Registry of Teachers, and individuals ordering Oak Ridge materials). Results from teacher interviews at the NSTA Convention are then summarized in the following section.

Questionnaire Survey Results

Survey results are presented below. Results are organized into three major areas: (1) Extent of use and use rates of DOE energy education materials, including reported reasons for non-use of materials, (2) User (teacher) evaluations of materials, and (3) Perceived user needs.

Extent of Use and Use Rates

An examination of extent of use of DOE energy education materials may proceed by considering data on numbers of materials disseminated. Data are shown in Table 1. For each item listed (curriculum package or fact sheet), the number of that item disseminated is shown. Figures given for an item represent the number disseminated (as of August 24, 1979) since the item was in print. Several of the items have been in print for 3 years. Since all items are disseminated upon request, the figures given represent request volumn.

Although inspection of the figures indicates a "large" request volume, in an absolute sense, the figures are difficult to translate into a rate (e.g., percent of teachers in our nation's schools requesting the materials). In any case, the figures reflect only requests for the materials and not their actual use (in classrooms) once received.

Data from Battelle's survey efforts bearing on extent of use and use rates are presented in Table 2. Column (5) in the table shows the number of questionnaires returned from the National Registry of Teachers sample, the Oak Ridge sample, and the NSTA Convention sample. As indicated, 316 questionnaires were returned from the sample of 2,000 teachers obtained from the National Registry of Teachers, for a questionnaire response rate of 15.8 percent [column (6)]. Corresponding returns and return rates are shown for the Oak Ridge sample and the NSTA Conference sample. For the NSTA Conference sample, calculation of a questionnaire return rate is not possible, due to the method of distributing the questionnaire forms.

Column (3) in the Table shows, of the responding group, the number of teachers that ordered or received the materials, for each of the three

TABLE 1. VOLUME OF DOE ENERGY EDUCATION MATERIALS DISSEMINATED

Curriculum Packages	Total Number Disseminated
• Award Winning Energy Education Activity	48,260
• Activities of DOE in Energy Education	5,440
• Solar Energy-Science Activities in Energy	110,100
• Wind Energy-Science Activities in Energy	48,200
• Solar Energy II-Science Activities in Energy	19,625
• Energy Conservation in the Home	39,732
• The Energy We Use (Grade 1)	82,285
• Community Workers and the Energy They Use	78,929
• Transportation and the City (Grades 8, 9)	50,690
• Energy, Engines and the Industrial Revolution	53,665
• How a Bill Becomes a Law to Conserve Energy	80,839
• Agriculture, Energy and Society	35,558
• Conservation-Science Activities in Energy	109,700
• Electrical Energy (Mini-Course)	85,900
• Chemical Energy (Mini-Course)	84,750
• Energy and Transportation (Grade 3)	15,370
• Two Energy Guides	9,588
• Networks-How Energy Links People, Goods, Services	23,174
• Bringing Energy to the People DC and GHA	20,045
• Mathematics in Energy (Grades 8-9)	39,202
• Energy Transitions in U.S. History	12,789
• Energy in the Global Marketplace	20,000
• U.S. Energy Policy-Which Direction	25,470
• Western Coal Boom or Bust	983
• Your Energy World	48,427
• Energy Activities with Energy Ant	92,565
Totals	1,235,286
Fact Sheets (NSTA)	
• Fuels from Plants (Bioconversion)	143,290
• Fuels from Wastes (Bioconversion)	147,390
• Wind Power	145,140
• Electricity from the Sun I	152,890
• Electricity from the Sun II	155,140
• Solar Sea Power	150,140
• Solar Heating and Cooling	222,640
• Geothermal Energy	144,390
• Energy Conservation Homes and Buildings	153,340
• Energy Conservation Industry	106,500
• Energy Conservation Transportation	154,090
• Conventional Reactors	117,540
• Breeder Reactors	126,365
• Nuclear Fusion	130,290
• New Fuels from Coal	140,640
• Energy Storage Technology	104,240
• Alternate Energy Sources Environmental Impact	119,750
• Alternate Energy Sources A Glossary of Terms	98,380
• Alternate Energy Sources A Bibliography	152,140
Totals	2,664,295

TABLE 2. EXTENT OF USE AND USE RATES OF ENERGY EDUCATION CURRICULUM MATERIALS

Respondents	Ordered or Received Materials?				(5)	(6)	(7)	(8)
	Yes			No				
	(1) Used Materials	(2) Did Not Use Materials	(3) Total	(4)	Total No. Questionnaires Returned	Response Rate	Extent of Use [(1)/(5)]	Use Rate [(1)/(3)]
• National Registry of Teachers Sample (2000)	13	7	20	296	316	15.8%	4.1%	65.0%
• Oak Ridge Sample (600)	44	29	73	119	192	32.0%	--	60.3%
• NSTA Convention Sample	32	17	49	77	126	--	--	65.3%
Totals	89	53	142	492	634	--	--	62.7%

sample groups. This number is further broken down by number of teachers actually using the materials in the classroom [column (1)] vs. not using the materials in the classroom [column (2)]. Column (4) of the table shows the number of teachers that neither ordered nor received the materials.

The percent of teachers actually using the materials in their classes can be taken as a measure of extent of use. Thus, for the National Registry of Teachers sample, only 4.1 percent of the responding teachers actually used the materials in their classes, as shown in column (7). As these teachers were asked only whether they used NSTA developed materials, this low extent of use rate (4.1 percent) pertains only to the extent of use of the NSTA developed materials, and not to the Oak Ridge developed materials.

Similar extent of use calculations are not provided for the Oak Ridge sample or the NSTA Convention sample, since such calcualtions would be seriously biased (too high). This is because the Oak Ridge group purportedly consists only of teachers that have ordered the materials,* thus excluding a large group of non-users. For the Convention sample, convention personnel encouraged those attendees familiar with the materials to complete the questionnaire form. Thus, percent of users in this group would likewise be biased upward.

In addition to extent of use of the materials, "use rates" were also calculated [column (8) of Table 2]. Percentages given show, of those teachers that ordered or received the materials, the percent using the materials in their classes. Thus, for example, of the 20 teachers ordering or receiving NSTA developed materials, 13 teachers, or 65.0 percent, actually used them in their classes. Since all 20 of these teachers had in fact received the materials (there were no teachers that had ordered but not yet received the materials), the use rate of 65.0 percent can be interpreted as the percent of teachers using the materials once they have them in hand.

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* It will be noted from Table 1 that, of the Oak Ridge group, 119 teachers reported not ordering or receiving the materials, even though all 600 teachers contacted had supposedly requested the materials from Oak Ridge. Follow-up with Oak Ridge personnel could not resolve this anomaly.

Similar use rates are shown for the Oak Ridge and NSTA Convention sample, i.e., on the order of 60 to 65 percent. Thus, for both NSTA and Oak Ridge developed materials, it may be concluded that approximately two-thirds of the teachers actually use the materials once they receive them.

For the approximate one-third of the teachers not using the materials (once they received them), reasons for non-use were sought (Item 7 of the questionnaire). Results are shown in Table 3. As indicated, principal reasons for non-use include limited class time available, and lack of teacher time to evaluate the materials, particularly for the Oak Ridge sample. Thus, for the Oak Ridge sample, 17 of the 29 non-users, or 58.6 percent, reported they did not use the materials because of limited class time, and 48.3 percent of the non-users reported they had no time to evaluate the material. Corresponding percentages for all three samples combined, shown in column (4) of Table 3, are 37.7 and 39.6 percent.

User Evaluations

The questionnaire solicited several kinds of evaluations from teachers who had used the curriculum materials in their classes. Evaluations made by teachers included: (1) Student interest level and relation of material to students' experience and background, (2) Relevance of materials to students' information needs and geographic region, (3) Achievement of learning objectives and impact of the materials on students' awareness and understanding of the energy situation, (4) Appropriateness of the reading level and the technical level of the materials, (5) Extent to which materials fit into units or subject matter taught, and constraints and limitations in use of materials.

Survey results in the above areas are presented below. Results are broken out by: (1) Users of Oak Ridge developed materials, (2) Users of NSTA developed materials, and (3) Users of both Oak Ridge and NSTA developed materials. This breakout permits a comparison of Oak Ridge and NSTA materials, in terms of teacher evaluation. Combined results are also given.

TABLE 3. REPORTED REASONS FOR NOT USING MATERIALS IN THE CLASSROOM (ITEM 7)

Response Category	(1) Oak Ridge Sample		(2) NSTA Conference Sample		(3) National Registry of Teachers Sample		(4) Combined Results (1, 2, and 3)	
	f	% (f/29)	f	% (f/17)	f	% (f/7)	f	% (f/53)
(a) Limited class time available	17	58.6	2	11.8	1	14.3	20	37.7
(b) Doubt usefulness of materials	1	3.4	0	0.0	1	14.3	2	3.8
(c) Doubt relevance to students	3	10.3	0	0.0	0	0.0	3	5.7
(d) Had no time to evaluate material	14	48.3	5	29.4	2	28.6	21	39.6
(e) Decided to use materials from another source	2	6.9	0	0.0	1	14.3	3	5.7
(f) Feel energy education should not be a part of the curriculum	0	0.0	0	0.0	0	0.0	0	0.0
(g) Passed materials on to other educators	11	37.9	0	0.0	1	14.3	12	22.6
(h) Used for teachers education	0	0.0	3	17.6	0	0.0	3	5.7
(i) Other	8	27.6	5	29.4	2	28.6	15	28.3

Tables 4, 5, and 6 show the frequency of use of specific packets, for users of Oak Ridge developed materials, NSTA developed materials, and users of both types of materials*. The most frequently used packets by users of Oak Ridge materials were packets 2 and 4 - Conservation - Science Activities in Energy; and Solar Energy - Science Activities in Energy. The most frequently used items by users of NSTA developed materials were the Fact Sheets on Alternative Energy Sources (packet 16).

In general, users of Oak Ridge developed materials primarily used those Oak Ridge packets designed for the elementary level, while users of NSTA developed materials primarily used those NSTA packets designed for the secondary level, as inspection of the percentages in Tables 4 and 5 show. Evaluation results presented below are to be interpreted accordingly.

Student Interest Level and Relation of Materials to Students Experience and Background. Results in these areas are given in Table 7, based on responses from items 13 and 14 of the questionnaire. Both users of Oak Ridge and NSTA developed materials report high student interest levels in the materials, as indicated by the relatively high frequency of response in the upper categories of the interest scale, and the relatively low frequency of response in the lower categories of the scale. Both groups of users also generally report that the materials are related to their students' experience and background, again as indicated by a relatively high percentage of teachers responding in the upper categories of the scale, and relatively few teachers responding in the lower or negative categories of the scale.

Users of both Oak Ridge and NSTA developed materials provide similar results [column (3) of Table 7]. Column (4) of the Table shows results from all three groups combined.

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* After distribution of the survey instruments, it was subsequently discovered that packet 7 as listed in Table 4 (Energy Conservation in the Home) was developed by the University of Tennessee, rather than Oak Ridge Associated Universities. It was also discovered that packet 7 as listed in Table 5 (Energy Conservation: Understanding and Activities for Young People) was developed by the Federal Energy Administration, rather than by NSTA. It is felt that these discrepancies do not affect in any significant way the major evaluation results obtained.

TABLE 4. PACKETS USED BY USERS OF OAK RIDGE DEVELOPED MATERIALS (ITEM 8)

Packet	No. Teachers Using Given Packet	% Teachers Using Given Packet*
1. Chemical Energy — Science Activities in Energy. 1977. Grades 4-6	21	50.0
2. Conservation — Science Activities in Energy. 1977. Grades 4-6	31	73.8
3. Electrical Energy — Science Activities in Energy. 1977. Grades 4-6	22	52.4
4. Solar Energy — Science Activities in Energy. 1977. Grades 4-6	32	76.2
5. Wind Energy — Science Activities in Energy. 1979. Elementary	6	14.3
6. Solar Energy II — Science Activities in Energy. 1979. Secondary	6	14.3
7. Energy Conservation in the Home: An Energy Education/Conservation Curriculum Guide for Home Economic Teachers. 1977. Senior High**	7	16.7

* Percentages given represent the percent of teachers responding to Item 8 that have used the given packet. 42 out of 46 teachers responded to Item 8.

** Developed by the University of Tennessee.

TABLE 5. PACKETS USED BY USERS OF NSTA DEVELOPED MATERIALS (ITEM 8).

	Packet	No. Teachers Using Given Packet	% Teachers Using Given Packet*
1.	The Energy We Use. 1977. Grade 1	2	7.7
2.	Community Workers and the Energy They Use. 1977. Grade 2	2	7.7
3.	Energy and Transportation. 1978. Grade 3	2	7.7
4.	Networks: How Energy Links People, Goods, and Services. 1978. Grades 4-5	0	0.0
5.	Your Energy World. 1978. Grades 4-6	1	3.8
6.	Bringing Energy to the People: Washington, D.C., and Ghana. 1978. Grades 6-7	3	11.5
7.	Energy Conservation: Understanding and Activities for Young People. 1975. Grades 7-9**	6	23.1
8.	Energy History of the United States. 1978. Grades 8-9	4	15.4
9.	Energy, Engines, and the Indutrial Revolution. 1977. Grades 8-9	4	15.4
10.	Mathematics in Energy. 1978. Grades 8-9	1	3.8
11.	Transportation and the City. 1977. Grades 8-9	3	11.5
12.	Energy in the Global Marketplace. 1978. Grades 9-11	3	11.5
13.	How a Bill Becomes a Law to Conserve Energy. 1977. Grades 9-12	2	7.7
14.	Agriculture, Energy, and Society. 1977. Grades 10-12	3	11.5
15.	U.S. Energy Policy — Which Direction? 1978. Grades 11-12	2	7.7
16.	Fact Sheets on Alternative Energy Sources. 1977	9	34.6
17.	Award Winning Energy Activities for Elementary and High School Teachers.	1	3.8

* Percentages given represent the percent of teachers responding to Item 8 that have used the given packet. 26 out of 29 teachers responded to Item 8.

** Developed by the Federal Energy Administration.

TABLE 6. PACKETS USED BY USERS OF BOTH OAK RIDGE AND NSTA DEVELOPED MATERIALS (ITEM 8)

Packet	Number of Teachers Using Given Packet	Percent* Teachers Using Given Packet
1. The Energy We Use. 1977. Grade 1.	3	25.0
2. Community Workers and the Energy They Use. 1977. Grade 2.	3	25.0
3. Energy and Transportation. 1978. Grade 3.	4	33.3
4. Bringing Energy to the People: Washington, D.C. and Ghana. 1978. Grades 6-7.	3	25.0
5. Networks: How Energy Links People, Goods, and Services. 1978. Grades 4-5.	4	33.3
6. Science Activities in Energy. 1977. Grades 4-6.	7	58.3
7. Chemical Energy - Science Activities in Energy. 1977. Grades 4-6.	7	58.3
8. Electrical Energy - Science Activities in Energy. 1977. Grades 4-6.	5	41.7
9. Solar Energy - Science Activities in Energy. 1977. Grades 4-6.	9	75.0
10. Your Energy World. 1978. Grades 4-6.	3	25.0
11. Energy History of the United States. 1978. Grades 8-9.	1	8.3
12. Energy Conservation: Understanding and Activities for Young People. 175. Grades 7-9.**	5	41.7
13. Energy, Engines, and the Industrial Revolution. 1977. Grades 8-9.	4	33.3
14. Mathematics in Energy. 1978. Grades 8-9.	3	25.0
15. Transportation and the City. 1977. Grades 8-9.	2	16.7
16. Agriculture, Energy, and Society. 1977. Grades 10-12.	3	25.0
17. Energy Conservation in the Home: An Energy Education/Conservation Curriculum Guide for Home Economics Teachers. 1977.***	4	33.0
18. Energy in the Global Marketplace. 1978. Grades 9-11.	2	16.7
19. How a Bill Becomes a Law to Conserve Energy. 1977. Grades 9-12.	3	25.0
20. U.S. Energy Policy - Which Direction? 1978. Grades 11-12.	4	33.0
21. Award Winning Energy Education Activities for Elementary and High School Teachers. 1977.	2	16.7

* Percentages given represent the percent of teachers responding to Item 8 that have used the given packet. 12 teachers indicated use of both Oak Ridge and NSTA developed materials.

** Developed by the Federal Energy Administration.

*** Developed by the University of Tennessee.

TABLE 7. USER EVALUATION OF STUDENT INTEREST LEVEL AND RELATION OF MATERIALS TO STUDENTS' EXPERIENCE AND BACKGROUND

	Response Category		(1) Users of Oak Ridge Developed Materials f*	(1) %	(2) Users of NSTA Developed Materials f	(2) %	(3) Users of Both Oak Ridge and NSTA Developed Materials f	(3) %	(4) Combined Results (1, 2, and 3) f	(4) %
Student Interest in Materials (Item 13)	Not at all interesting	1	0	0.0	0	0.0	0	0.0	0	0.0
		2	2	4.4	2	8.7	0	0.0	4	5.1
		3	8	17.8	6	26.1	1	9.1	15	19.0
		4	21	46.7	11	47.8	6	54.5	38	48.1
	Very interesting	5	14	31.1	4	17.4	4	36.4	22	27.8
			45	100.0%	23	100.0%	11	100.0%	79	100.0%
	Response Category		f	%	f	%	f	%	f	%
Relation of Materials to Students' Experience and Background (Item 14)	Not at all related	1	1	2.2	3	13.6	0	0.0	4	5.1
		2	4	8.9	0	0.0	2	18.2	6	7.7
		3	13	28.9	3	13.6	3	27.3	19	24.4
		4	17	37.8	9	40.9	5	45.5	31	39.7
	Very much related	5	10	22.2	7	31.8	1	9.1	18	23.1
			45	100.0%	22	100.0%	11	100.0%	78	100.0%

* f = number of teachers circling the given response category.

Relevance of Materials. Teacher users were asked to rate the extent to which the content of the material is relevant to their students' information needs, and the extent to which the topics covered in the material are relevant to the local geographic region (Items 15 and 16). Results are presented in Table 8. Results obtained are similar to teacher evaluation of student interest level and relation of materials to students' experience and background. Thus, all user groups generally believe the material is relevant to both their students' information needs and geographic region, as indicated by the relatively large number of teachers responding in the higher levels of the scale for each item.

Achievement of Learning Objectives and Impact of Materials. Items 17 and 18 of the questionnaire provided for teacher evaluation of extent to which students achieve the learning objectives of the materials, and extent to which materials have an impact on students' awareness and understanding of the energy situation in our country. Results are shown in Table 9. As shown, users of Oak Ridge materials generally indicate that students achieve the learning objectives of the materials, with only about 9 percent of the teachers responding in the two lower response categories. Evaluation of achievement of learning objectives by users of NSTA materials is not quite as favorable, with about 28% of the users responding in the lower two response categories.

Users of Oak Ridge materials indicate a relatively high impact of the materials on students' awareness and understanding of the energy situation, as shown in Table 9. Users of NSTA materials also provide a generally favorable evaluation of impact, although not as favorable as the Oak Ridge users.

Appropriateness of Reading Level and Technical Level of Materials. As shown in Table 10, the large majority of all user groups believe both the reading and technical levels of the materials to be appropriate, with percentages of teachers indicating an appropriate level ranging from 72.1 percent to 90.5 percent. However, significant percentages in both the Oak Ridge and NSTA groups believe the reading level to be too high (18.2 percent and 22.7 percent respectively), and a significant percentage of the Oak Ridge users believe the technical level to be too high (18.6 percent).

TABLE 8. USER EVALUATION OF RELEVANCE OF MATERIALS

	Response Category		(1) Users of Oak Ridge Developed Materials		(2) Users of NSTA Developed Materials		(3) Users of Both Oak Ridge and NASTA Developed Materials		(4) Combined Results (1, 2, and 3)	
			f	%	f	%	f	%	f	%
Relevance of Materials to Students' Information Needs (Item 15)	Not at all relevant	1	1	2.2	2	8.7	0	0.0	3	3.8
		2	1	2.2	0	0.0	0	0.0	1	1.2
		3	7	15.6	3	13.0	1	8.3	11	13.8
		4	19	42.2	9	39.1	6	50.0	34	42.5
	Very relevant	5	17	37.8	9	39.1	5	41.7	31	38.8
			45	100.0%	23	100.0%	12	100.0%	80	100.0%
	Response Category		f	%	f	%	f	%	f	%
Relevance of Materials to Geographic Region (Item 16)	Not at all relevant	1	0	0.0	2	9.5	0	0.0	2	2.6
		2	3	6.5	0	0.0	0	0.0	3	3.8
		3	9	19.6	3	14.3	4	36.4	16	20.5
		4	15	32.6	9	42.9	4	36.4	28	35.9
	Very relevant	5	19	41.3	7	33.3	3	27.3	29	37.2
			46	100.0%	21	100.0%	11	100.0%	78	100.0%

TABLE 9. USER EVALUATION OF ACHIEVEMENT OF LEARNING OBJECTIVES AND IMPACT OF MATERIALS

	Response Category		(1) Users of Oak Ridge Developed Materials f	(1) %	(2) Users of NSTA Developed Materials f	(2) %	(3) Users of Both Oak Ridge and NSTA Developed Materials f	(3) %	(4) Combined Results (1, 2, and 3) f	(4) %
Achievement of Learning Objectives of Material (Item 17)	Few students generally learn the material	1	1	2.3	3	16.7	1	10.0	5	7.0
		2	3	7.0	2	11.1	3	30.0	8	11.3
		3	9	20.9	5	27.8	2	20.0	16	22.5
		4	16	37.2	7	38.9	4	40.0	27	38.0
	Most students generally learn the material	5	14	32.6	1	5.6	0	0.0	15	21.1
			43	100.0%	18	100.0%	10	100.0%	71	100.0%

	Response Category		f	%	f	%	f	%	f	%
Impact of Materials (Item 18)	No impact	1	0	0.0	1	5.3	0	0.0	1	1.5
		2	1	2.5	2	10.5	0	0.0	3	4.5
		3	9	22.5	3	15.8	1	14.3	13	19.7
		4	16	40.0	6	31.6	4	57.1	26	39.4
	Appreciable impact	5	14	35.0	7	36.8	2	28.6	23	34.8
			40	100.0%	19	100.0%	7	100.0%	66	100.0%

TABLE 10. USER EVALUATION OF APPROPRIATENESS OF READING LEVEL AND TECHNICAL LEVEL OF MATERIALS

	Response Category	(1) Users of Oak Ridge Developed Materials f	(1) %	(2) Users of NSTA Developed Materials f	(2) %	(3) Users of Both Oak Ridge and NSTA Developed Materials f	(3) %	(4) Combined Results (1, 2, and 3) f	(4) %
Appropriateness of Reading Level (Item 19)	(a) Reading level appropriate	33	75.0	17	77.3	10	90.1	60	77.9
	(b) Reading level too high	8	18.2	5	22.7	0	0.0	13	16.9
	(c) Reading level too low	3	6.8	0	0.0	1	9.1	4	5.2
		44	100.0%	22	100.0%	11	100.0%	77	100.0%
	Response Category	f	%	f	%	f	%	f	%
Appropriateness of Technical Level (Item 20)	(a) Technical level appropriate	31	72.1	19	90.5	8	80.0	58	78.4
	(b) Technical level too high	8	18.6	2	9.5	1	10.0	11	14.9
	(c) Technical level too low	4	9.3	0	0.0	1	10.0	5	6.8
		43	100.0%	21	100.0%	10	100.0%	74	100.0%

Extent to Which Materials Fit Into Units or Subject Matter Taught, and Constraints and Limitations in Use of Materials. All user groups generally indicate that the materials fit into units or subject matter taught (see Table 11). This finding is of particular relevance, since materials were designed to be easily integrated into the regular classroom.

Teachers were asked whether any factors hindered use of the materials (Item 23). For users of Oak Ridge developed materials, a significant percentage of teachers (31.8 percent) indicated that the time required hindered use of the materials (see Table 11). Also, 25 percent of the Oak Ridge users indicated that the materials/equipment required hindered use of the materials.

For users of NSTA developed materials, a significant percentage (27.8 percent) also indicated that time required hindered use of materials. However, only 1 out of 18 teacher-users of NSTA developed materials indicated that materials/equipment required hindered use of the materials.

A greater percentage of the NSTA materials users indicated that no factors hindered use of materials than for users of Oak Ridge developed materials (61.1 percent vs. 43.2 percent).

Teachers were asked whether they felt special or additional teacher training is necessary for effective use of the materials (Item 22). In all user groups, the majority of teachers responded "no" to this item (see Table 11). However, the percent responding "no", of the Oak Ridge materials group, was higher than for the NSTA materials group (82.2 percent vs. 65.2 percent). A significant percentage of users of NSTA developed materials (34.8 percent) feel that special or additional instructor training is required.

Likelihood of School Purchasing Energy Education Materials. Teachers were asked how likely their school would be to purchase the energy education materials if each packet cost $2-3 (Item 27). In each of the Oak Ridge and NSTA user groups, about 33 percent of the teachers responded "not at all likely" (see Table 12), and about 40 percent responded "probably". Relatively few teachers responded "definitely".

TABLE 11. USER EVALUATION OF EXTENT TO WHICH MATERIALS FIT INTO UNITS OR SUBJECT MATTER TAUGHT, AND CONSTRAINTS AND LIMITATIONS IN USE OF MATERIALS

	Response Category		(1) Users of Oak Ridge Developed Materials f	(1) %	(2) Users of NSTA Developed Materials f	(2) %	(3) Users of Both Oak Ridge and NSTA Developed Materials f	(3) %	(4) Combined Results (1, 2, and 3) f	(4) %
Extent to which Materials Fit into Units or Subject Matter Taught (Item 12)	Not at all	1	2	4.4	1	3.8	0	0.0	3	3.7
		2	3	6.7	2	7.7	0	0.0	5	6.0
		3	7	15.6	1	3.8	1	8.3	9	10.8
		4	16	35.6	5	19.2	3	25.0	24	28.9
	Very well	5	17	37.8	17	65.4	8	66.7	42	50.6
			45	100.0%	26	100.0%	12	100.0%	83	100.0%

	Response Category	f	%(f/44)	f	%(f/18)	f	%(f/11)	f	%(f/73)
Factors Hindering Use of Materials (Item 23)	(a) None	19	43.2	11	61.1	8	72.7	38	52.1
	(b) Time required	14	31.8	5	27.8	1	9.1	20	27.4
	(c) Space required	0	0.0	1	5.6	0	0.0	1	1.4
	(d) Materials/equip. required	11	25.0	1	5.6	1	9.1	13	17.8
	(e) Not fit into subjects taught	4	9.1	0	0.0	0	0.0	4	5.5
	(f) Other factors	4	9.1	2	11.1	2	18.2	8	10.6

	Response Category	f	%	f	%	f	%	f	%
Requirement for Special or Additional Instructor Training (Item 22)	(a) Yes	8	17.8	8	34.8	4	36.4	20	25.3
	(b) No	37	82.2	15	65.2	7	63.6	59	74.7
		45	100.0%	23	100.0%	11	100.0%	79	100.0%

TABLE 12. USER EVALUATION OF LIKELIHOOD OF SCHOOL PURCHASING ENERGY EDUCATION MATERIALS (ITEM 27)

Response Category	(1) Users of Oak Ridge Developed Materials		Users of NSTA Developed Materials		(3) Users of Both Oak Ridge and NSTA Developed Materials		(4) Combined Results (1, 2, and 3)	
	f	%	f	%	f	%	f	%
• Not at all likely	15	33.3	8	33.3	1	9.1	24	30.0
• Probably	18	40.0	10	41.7	8	72.8	36	45.0
• Definitely	0	0.0	4	16.7	1	9.1	5	6.2
• Do not know	12	26.7	2	8.3	1	9.1	15	18.8
	45	100.0%	24	100.0%	11	100.0%	80	100.0%

Sources Where Users Learn of the Availability of Materials.

It is of interest to know where users learn of DOE energy education materials, since this knowledge may relate to promotional practices for increasing extent of use of the materials. As shown in Table 13, most users of Oak Ridge developed materials learned about the materials either through Journal ads/articles or NSTA information sources. For users of NSTA developed materials, most users learned about the materials through NSTA information and "other" sources. Combined results for all user groups shows about 25 percent of the teachers learning about the materials through Journal ads/articles; about 45 percent through NSTA information sources; and about 14 percent through other teachers. Thus, journal ads/articles and NSTA information sources are the major identified means by which users learn of the availability of materials.

Perceived User Needs

Teachers were asked, for their grade level(s) and subject area(s) taught, whether any media or prescribed learning activities should be added to existing materials to more effectively teach their students an awareness and understanding of the world of energy (Items 25 and 26).

Results are shown in Table 14. As shown, the very large majority of teachers in all user groups thought that some kind of additional media were needed, and also that additional learning activities of some kind were needed, since relatively few teachers responded to the "none" category. For additional media, for all three user groups combined, more than half of the teachers (57.4 percent) thought that film strips should be added to existing materials, with somewhat fewer teachers perceiving a need for additional graphics and audio cassettes (45.6 and 36.8 percent respectively). In the area of additional learning activities, significant numbers of teachers in all user groups indicate that field trips, guest speakers, in-home activities, student group discussions/activities and individual projects all should supplement existing materials. For each of these learning activities, at least one-third of the teachers in each group (with the exception of student group discussions/activities for the users of both Oak Ridge and NSTA developed materials), indicate that the given activity was needed, with this percent approaching 40-50 for users of Oak Ridge developed materials.

TABLE 13. SOURCES WHERE USERS LEARNED OF THE AVAILABILITY OF MATERIALS (ITEM 21).

	(1) Users of Oak Ridge Developed Materials		(2) Users of NSTA Developed Materials		(3) Users of Both Oak Ridge and NSTA Developed Materials		(4) Combined Results (1, 2, and 3)	
Source	f	%(f/46)	f	%(f/22)	f	%(f/11)	f	%(f/79)
• Journal ads/articles	19	41.3	1	4.5	0	0.0	20	25.3
• NSTA information sources	19	41.3	11	50.0	5	45.5	35	44.3
• Other teachers	8	17.4	1	4.5	2	18.2	11	13.9
• School supervisor, coordinator, principal, librarian	4	8.7	2	9.1	0	0.0	6	7.6
• Other	9	19.6	6	27.3	5	45.5	20	25.3

TABLE 14. PERCEIVED USER NEEDS: ADDITIONAL MEDIA AND LEARNING ACTIVITIES

		(1) Users of Oak Ridge Developed Materials		(2) Users of NSTA Developed Materials		(3) Users of Both Oak Ridge and NSTA Developed Materials		(4) Combined Results (1, 2, 3)	
	Response Category	f	%(f/38)	f	%(f/21)	f	%(f/9)	f	%(f/68)
Additional Media Needed (Item 25)	(a) None	6	15.8	0	0.0	0	0.0	6	8.8
	(b) Graphics	16	42.1	10	47.6	5	55.6	31	45.6
	(c) Film strips	24	63.2	10	47.6	5	55.6	39	57.4
	(d) Audio Cassettes	16	42.1	7	33.3	2	22.2	25	36.8
	(e) Videotape	9	23.7	9	42.9	1	11.1	19	27.9
	(f) Other	5	13.2	4	19.0	0	0.0	9	13.2
	Response Category	f	%(f/42)	f	%(f/21)	f	%(f/11)	f	%(f/74)
Additional Learning Activities Needed (Item 26)	(a) None	2	4.8	5	23.8	0	0.0	7	9.4
	(b) Field trips	22	52.4	7	33.3	3	27.3	32	43.2
	(c) Guest speakers	17	40.5	7	33.3	4	36.4	28	37.8
	(d) In-home activities	15	35.7	8	38.1	6	54.5	29	39.2
	(e) Student group discussions/activities	18	42.9	7	33.3	1	9.1	26	35.1
	(f) Individual projects	22	52.4	12	57.1	7	63.6	41	55.4
	(g) Other	4	9.5	1	4.8	0	0.0	5	6.8

Perceived user needs were also assessed by means of an open-ended type question. Teachers were asked, for their grade level(s) and subject area(s), what additional packets should be developed or what additional topics covered to teach their students an awareness and understanding of the world of energy (Item 24). For this item, several teachers in each user group did not respond to the item. Thus, for users of Oak Ridge developed materials, 24 of 46 teachers responded; 10 out of 29 teachers responded for users of NSTA developed materials, and 4 out of 12 teachers responded for users of both Oak Ridge and NSTA developed materials. Assuming for this item that non-responses can be interpreted as "none" (no additional packets should be developed or additional topics covered), then the percent of teachers in each user group believing that some kind of additional packet should be developed or an additional topic covered, can be taken as 24/46 = 52.2 percent, 10/29 = 34.5 percent, and 4/12 = 33.3 percent, in each user group respectively. Thus, significant numbers of teachers in each user group indicate that an additional packet(s) should be developed or an additional topic covered.

Particular packets that should be developed or additional topics covered, as indicated by teachers, are shown in Tables 15, 16, 17, and 18, for each of the three user groups and for all three groups combined. As can be seen, responses are diverse. For users of Oak Ridge developed materials, the most frequently indicated packets that should be developed or topics covered are nuclear/fusion, conservation, and alternative energy projects, with four teachers indicating that each of these packets/topics are needed. For all three user groups combined (Table 18), nuclear/fusion, solar energy, wind, biomass, and conservation were the most frequently indicated needs.

TABLE 15. PERCEIVED USER NEEDS: ADDITIONAL PACKETS THAT SHOULD BE DEVELOPED OR ADDITIONAL TOPICS COVERED (ITEM 24) (USERS OF OAK RIDGE MATERIALS)

Additional Packet or Topic		Frequency*
• Nuclear; fusion		4
• Another solar packet; sun		3
• Non-renewable sources compared to solar		1
• Water energy		2
• Geothermal energy		1
• Hydroelectric power		1
• Wind		1
• Biomass		1
• Gasahol (new sources packet)		1
• Conservation:		4
- On all levels	2	
- Elementary level home conservation	2	
• Alternative energy projects		4
• More materials related to life sciences		1
• More basic materials		1
• More chemistry		1
• Fossil fuel problems		1
• Energy flow in natural systems		1
• Politics of the energy problem		1
• Values clarification and energy		1
• Health and energy		1
• Games		1
• Supplement SCIS curriculum		1

*Frequencies given represent the number of teachers indicating that a given additional packet should be developed or an additional topic covered. Out of the 46 teachers, 24 responded to the item.

TABLE 16. PERCEIVED USER NEEDS: ADDITIONAL PACKETS THAT SHOULD BE DEVELOPED OR ADDITIONAL TOPICS COVERED (ITEM 24) (USERS OF NSTA DEVELOPED MATERIALS)

Additional Packet or Topic	Frequency*
• Nuclear	1
• Solar energy	2
• Wind power	1
• Biomass production of energy	1
• Bio conversion	1
• Petroleum, new finds	1
• Energy from the oceans	1
• How to conserve	1
• Personal use of energy	1
• More on environmental impact of new energy sources	1
• Relate energy as a science	1
• Energy used in manufacturing appliances as well as using them	1
• Oil producing nations -- exporting and regulating prices	1
• How to calculate	1

*Frequencies given represent the number of teachers indicating that a given additional packet should be developed or an additional topic covered. Out of the 29 teachers, 10 responded to the item.

TABLE 17. PERCEIVED USER NEEDS: ADDITIONAL PACKETS THAT SHOULD BE DEVELOPED OR ADDITIONAL TOPICS COVERED (ITEM 24) (USERS OF BOTH OAK RIDGE AND NSTA DEVELOPED MATERIALS)

Additional Packet or Topic	Frequency*
• Biomass	2
• Wind	1
• Basic concepts	1
• Limitations and advantages of alternative energy sources	1

*Frequencies given represent the number of teachers indicating that a given additional packet should be developed or an additional topic covered. Out of the 12 teachers, 4 responded to the item.

TABLE 18. PERCEIVED USER NEEDS: ADDITIONAL PACKETS THAT SHOULD BE DEVELOPED OR ADDITIONAL TOPICS COVERED (ITEM 24) (COMBINED RESULTS FROM ALL THREE SAMPLES)

Additional Packet or Topic	Frequency*
• Nuclear; fusion	5
• Solar energy; another solar packet, sun; non-renewable sources compared to solar	6
• Wind; wind power	3
• Biomass; biomass production of energy; bioconversion	5
• Water energy	2
• Geothermal energy	1
• Hydroelectric power	1
• Gasahol (new sources packet)	1
• Conservation:	6
- On all levels; how to conserve; personal use of energy	4
- Elementary level home conservation	2
• Alternative energy projects	4
• Basic concepts; more basic materials	2
• More materials related to life sciences	1
• More chemistry	1
• More on environmental impact of new energy sources	1
• Fossil fuel problems	1
• Energy flow in natural systems	1
• Petroleum, new finds	1
• Energy from the oceans	1
• Limitations and advantages of alternative energy sources	1
• Relate energy as a science	1
• Energy used in manufacturing appliances as well as using them	1
• Oil producing nations -- exporting and regulating prices	1
• Politics of the energy problem	1
• Values clarification and energy	1
• Health and energy	1
• Games	1
• How to calculate	1
• Supplement SCIS curriculum	1

*Frequencies given represent the number of teachers indicating that a given additional packet should be developed or an additional topic covered. Out of the 87 teachers in all three samples combined, 38 teachers responded to the item.

Summary of Principal Findings

Some of the previously presented results are based on relatively small sample sizes and low questionnaire return rates. Additional related studies that might serve to corroborate the results were not identified (e.g., additional studies related to extent of use of the materials). Nevertheless, it is felt that the results obtained are at least suggestive, and often more so, and of substantive value. Principal results from the questionnaire surveys may be summarized as follows:

- The extent to which secondary level science, social science, and mathematics teachers use NSTA developed materials appears to be low, in that only 4 percent of responding teachers indicated any use of these materials in their classes. This figure of 4 percent may even be high, because of the expected tendency of users of the materials to return the questionnaire forms.
- Comparable questionnaire information on extent of use of Oak Ridge developed materials is not available. However, teacher interview results (see next section) suggest low extent of use of these materials, since many teachers do not know of the existence of the materials.
- More definitive information is needed on extent of use, in our nation's schools, of both NSTA and Oak Ridge developed materials, and factors underlying use-nonuse of materials. This information could be obtained through a more extensive survey effort than was possible within the scope of this project. A more extensive survey effort has been outlined as part of a Battelle proposal currently submitted to DOE ("Evaluation of Extent of Use and Impact of DOE Energy Education Materials").

- Of the teachers reporting that they have received and have in hand energy education materials, about two-thirds of them actually use the materials in their classes. This is true for teachers receiving the NSTA developed materials, as well as for teachers receiving Oak Ridge developed materials. For the one-third of the teachers receiving but not using the materials, principal reported reasons for nonuse included limited class time available, and lack of time to evaluate the materials.

- Teacher users of the materials generally provided a favorable evaluation of the materials. Both teacher-users of Oak Ridge and teacher-users of NSTA developed materials generally reported:
  - High student interest levels in the materials and that the materials are related to their students' experience and background
  - That the materials are relevant to both their students' information needs and geographic region
  - That students achieve the learning objectives of the materials (more so for users of Oak Ridge developed materials than for users of NSTA developed materials)
  - A relatively high impact of the materials on students' awareness and understanding of the energy situation
  - That the reading and technical levels of the materials are appropriate to their students
  - That the materials fit into existing units or subject matter taught, and with most teachers reporting no additional teacher training required for effective use of the materials.

- Although user results as cited above indicate a generally favorable evaluation of the materials, it is important

to note that a significant percentage of both users of Oak Ridge and NSTA developed materials indicated that time required hindered use of the materials (32 and 28 percent, respectively). Also, about one-quarter of the Oak Ridge users indicated that materials/equipment required hindered use of the materials. Further, about 35 percent of the users of the NSTA developed materials felt that special or additional instructor training is required to use the materials effectively.

- As an additional qualification on the generally favorable user evaluation of the materials, the very large majority of teachers in all user groups thought that some kind of additional media were needed, and also that additional learning activities of some kind were needed, to more effectively teach their students an awareness and understanding of the world of energy. For example, more than half of the teachers (57 percent) thought that film strips should be added to existing materials. Also, significant numbers of teachers perceived a need for additional graphics (46 percent), and for audio cassettes (37 percent). In the area of needed learning activities, at least one-third of the teachers indicated that field trips, guest speakers, in-home activities, student group discussion/activities, and individual projects were all needed. Often, more than one-third of the teachers indicated that a given learning activity was needed (often approaching 50 percent), depending on the particular activity and user group. Finally, significant numbers of teachers (between one-third and one-half, depending on the particular user group) thought that some kind of additional packet should be developed or an additional topic covered. Packets/topics suggested were diverse in nature, but results suggested a felt need by several teachers for additional content.

Summary of Teachers' Interviews

As previously indicated, one approach used to acquire information on perceptions of energy education curriculum materials was through personal interviews with teachers at the 1979 National Science Teacher's Association Convention. Teachers, university teaching staff, and school supervisors/administrators who had experience with DOE's curriculum materials were interviewed.

The comments obtained should be considered as a supplemental source of information to the questionnaire surveys. The teachers' perceptions of the materials are summarized below.

- The interdisciplinary approach used in NSTA-produced materials is good. One teacher had used the idea to integrate energy topics into reading and gave tests in comprehension and writing of energy terms. Some teachers, however, do not understand this approach. They need to have it explained in the introduction or have it demonstrated before using it themselves. This suggests that pre-service training may need to address the meaning and implementation of the interdisciplinary approach as an alternative. Workshops, or some other means to inservice training may be useful.
- The materials appear to teachers to be adaptable (particularly Oak Ridge Associated Universities materials). For example, even though a given set of materials may be designed for Grades 4 and 5, they can be used by high school students, or other elementary grade levels. Similarly, they can be adapted for gifted or slow learners' use. Material packages can literally be taken apart and used with a classroom of children who are operating at different knowledge levels.

- Most teachers do not know that the DOE materials exist. There needs to be more advertising or outreach activities so that materials are more visible in the teaching community.
- Methods that are not lecture or book work interest students more. Hands-on work will teach material better. Lessons using simulation or gaming also are needed to capture student interest.
- There were only a few suggestions as to topic areas that needed to be included in the materials. Those mentioned included earth science for the junior high school level, biomass for senior high school level, and materials that stress the diversity of energy sources and provide guidance in matching a source to its best use.
- Most teachers were pleased with the materials. There was some indication that teachers positive toward the materials would pay for the now free materials, even if their school district would not.

In general, it appears that the teachers' comments support the questionnaire survey data as well as Battelle researchers' perceptions of the energy education materials.

III. PROGRAM EVALUATION

During the six-month on-site assignment in the Education Programs Division, Dr. Miller not only assisted in the technical review and guidance for specific projects, but also examined the total curriculum development program within the Division. A summary of Dr. Miller's observations are presented below.

Communication Between Program Developers and DOE Staff

Because N.S.T.A. is the Division's major contractor and because N.S.T.A. is located in Washington, D.C., Dr. Miller observed a frequent exchange of planning and information between the staffs of N.S.T.A. and the DOE. Communication between other contractors and DOE staff, because of distance and various lengths of contracts, was not as regular or as frequent as with N.S.T.A.

The Chief of the Academic Programs Branch maintained contact with contractors in an admirable fashion, given the number of major on-going curriculum development projects and the small staff with which the Chief was provided.

Indeed, a major criticism of the Division organization is that the number of staff assigned to the Education Programs Division is entirely inadequate for the number and size of major projects funded by this Division. Presently, only two permanent staff members are in charge of handling the management of these projects as well as the daily business which is delegated to this Division.

While acknowledging the present uncertainties which characterize the organizational changes within DOE, the major recommendation for improving communication between program developers and DOE staff is to increase the staff by at least two professional positions so that quality attention might be paid to all aspects of materials development projects under way through contracts with the Education Programs Division.

Adequacy of the Publicity and Dissemination Procedures Utilized

The majority of curriculum materials developed for DOE are available from the DOE's Technical Information Center (TIC) in Oak Ridge, Tennessee. While TIC's records indicate a large request volume for the materials, much of Battelle's initial research into the extent of use of these materials (see Section II) indicates that many teachers, supervisors and administrators are unaware of the existence of these energy education materials.

Personal reports of encounters with teachers in the field, provided by Dr. Janet Miller and Ms. Jean Newborg (see Section II) as well as by the director of the Faculty Development Programs of DOE, indicate that much more publicity is needed to inform the general teaching community of the availability of these materials.

Specific recommendations for improved publicity and dissemination procedures include:

- Inserting a perforated card into every set of materials mailed; this card could be filled out and mailed back to DOE by the teacher, supervisor, or administrator who had utilized the materials, thus providing user access information as well as user reaction information. This procedure would insure a user population for any additional evaluation which DOE might wish to pursue.
- Advertising the availability of these free curriculum materials through educational journals, periodicals, and newsletters.
- Installing DOE curriculum information booths at major education conferences, especially at ones such as the N.S.T.A. National Convention. The attendees of such conferences usually are enthusiastic and eager for new information. (Response cards could also be inserted in these materials.)

Requirements, Processes, and Guidelines Used to Determine Informational Needs of the Educational Community and the General Public

During much of the six-months on-site assignment at DOE, the on-site researcher observed the Directorship of the Division being occupied by two individuals, the resignation of the most recent Director, and the loss of professional staff positions within the Education Programs Division. Such events obviously resulted in an unsettled atmosphere within the Division and contributed to the varying requirements and guidelines which were used to determine informational needs.

A specific perspective which then defines major goals of the Division is needed to establish guidelines and requirements for development of specific curriculum projects. For example, decisions must be made in reference to target audiences with regard to future curriculum development: will the Division continue to support development of materials for K-12? Will the emphasis shift to materials development for vocational/technical training in the energy areas? Questions such as these need to be addressed before the Division can settle upon specific requirements and objectives for its curriculum projects.

As indicated above, a specific perspective which guides the work of the Division is not discernible at this point. Thus, no specific procedures exist for determining informational needs. This appears to be an area, along with the informational needs issue discussed above, which deserves priority as the Division moves into its new organizational structure.

The individual programs which are run and supported by the Education Programs Division are of value within the educational mission of DOE. The staff works diligently to direct the various activities within the Division, and their efforts are laudable. However, the work which now exists as well as the potential projects which could be enacted within this Division demand a reasonably-sized staff and a specifically defined and articulated perspective which can guide the activities within the Division. The people now working within the Education Programs Division are committed to all of

the tenets which characterize energy education; they should be provided with the staff support as well as philosophical perspective which would enable them to continue in the vital mission of providing energy education to American citizens.

IV. CONCLUSIONS AND RECOMMENDATIONS

Principal conclusions and recommendations from this study are presented below. They are organized into the following areas: (1) Extent of use of DOE energy education materials and recommendations for increasing extent of use, (2) User evaluation of the materials and perceived needs, (3) Current evaluation procedures and recommendations for evaluation studies and improved evaluation procedures, and (4) Operation of the Education Programs Division.

Extent of Use

- The extent of use of DOE energy education curriculum materials appears quite limited in our nation's schools. However, more definitive information is needed on extent of use, and factors underlying use-nonuse of the materials. This information should be obtained through the conduct of a more extensive survey effort than was possible within the scope of the current project. A more extensive survey effort has been outlined as part of a Battelle proposal currently submitted to DOE ("Evaluation of Extent of Use and Impact of DOE Energy Education Materials").

- Based on the results of the current study, a principal reason for low extent of use is that significant numbers of teachers do not know the materials exist. In addition, for teachers that are aware of the materials and that have ordered them, significant numbers do not use the materials once they receive them.

- In order to increase extent of use of DOE energy education materials, the Education Programs Division should adopt a proactive approach to dissemination. That is, there is a need for a plan to systematically reach out to target populations (science, mathematics, and social science teachers). This should be accomplished through exhibits

at national, regional, and/or state conventions of these teachers; announcements of material availability in journals, newsletters, and other publications which reach a large number of teachers; and other appropriate approaches.

- As an additional means to increase extent of use, the Education Programs Division should develop a plan that would expose preservice teachers to the materials. Staff and faculty within the college/university Department of Education should be made aware of the existence of DOE materials so they can present the materials as resources to be used in the elementary/secondary school classroom. Exposure to energy education materials during preservice training make it more likely that a future teacher would consider them an opportunity to present the topic of energy, rather than an "add-on" to the existing curriculum once a teacher has taught for several years.

User Evaluation and Perceived Needs

- Teacher users of the materials generally provide a favorable evaluation of the materials, in terms of student interest in the materials and relation of the materials to students' experience and background; relevance of the materials to students' information needs and geographic region; achievement of learning objectives and impact of the materials on students' awareness and understanding of the energy situation; appropriateness of the reading and technical levels of the materials; and ease with which the materials fit into existing curricula. However, both Battelle researchers and many teacher users perceive a need for supplementary provisions and mechanisms which would more actively involve students in the learning process.

In addition, consideration should be given to developing some materials which could be utilized within the disciplines of the humanities.

Evaluation Procedures

- To date, most of the evaluation of DOE energy education materials has been performed at a teacher reaction level, with little attention given to the changes in student skills, knowledges, and behavior as a result of exposure to the curriculum materials. While teacher reaction is a valid form of evaluation, it does not answer the more important questions related to extent and nature of impact on students.

- A comprehensive, systematic, and scientific evaluation should be conducted to assess the impact on students of DOE energy education materials currently being distributed nationally to teachers. Such an evaluation study has been outlined in detail in a Battelle proposal currently submitted to DOE ("Evaluation of Extent of Use and Impact of DOE Energy Education Materials").

- In addition, consideration should be given to including more thorough and comprehensive student impact evaluation as part of the process of developing new packages. For example, prior to the release of a package publically, field testing of the package should have occurred to determine the extent to which specified student learning objectives are achieved, and any modifications in the package made accordingly. This procedure would go beyond field testing to obtain only teacher reaction to the materials.

- A procedure should be developed to obtain teacher feedback on distributed materials. This could be accomplished by including postcards with materials distributed by the

Technical Information Center which solicit cooperation in assessing the materials. Accumulating a listing of material receivers (i.e., those who requested and were sent materials within a specified period of time, say the most recent six month period) would greatly facilitate evaluation of specific materials. For example, it would supplement extent of use information by determining not only how many people ordered materials, but also how many teachers actually used them and how many students were reached.

DOE Operation

- The Education Programs Division should formalize mechanisms for determining the educational information needs of teachers, students, and the general public. Based on the Education Programs Division's missions, goals, and objectives, along with determined information needs, plans and guidelines should be developed to assist the Division in determining curriculum materials that are yet needed, in evaluating unsolicited proposals, in systematically disseminating existing materials, and in evaluating curriculum materials.
- The Division should increase the staff to more effectively carry out instructional design, materials dissemination, and educational services.
- To enhance cohesiveness and communication among staff of the Division, there should be more planned efforts directed toward planned discussions, meetings, and circulated documentation of current activities and needs.

APPENDIX A

TEACHER SURVEY INSTRUMENT

NATIONAL SCIENCE TEACHERS ASSOCIATION

AN AFFILIATE OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

1742 CONNECTICUT AVENUE, N.W. WASHINGTON, D.C. 20009 • TELEPHONE: AREA CODE 202 • 265-4180

Robert L. Silber — *Executive Director*

ENERGY EDUCATION CURRICULUM EVALUATION

We need your help to evaluate energy education curriculum materials. Please take just a few minutes to complete the following questions. A listing of the materials with which we are particularly concerned is attached for reference, and you may detach and use the list as a resource. *Even if you have not used the materials,* please complete items 1-7 and return the form in the enclosed envelope. Forms should be returned *within two weeks from their receipt.*

Your participation is voluntary and you may choose not to answer any of the questions. Do not sign your name. Return of the form denotes your consent to participate and your agreement to our use of your responses.

Thank you for sharing your information with us.

1. What is your job position? a) elementary teacher___ b) secondary teacher___
   c) elementary or secondary curriculum coordinator___ d) college/university faculty___
   e) other (specify)_____ (5)

2. What grade level(s) do you teach? Circle applicable level(s).
   K 1 2 3 4 5 6 7 8 9 10 11 12 Post-secondary (6-8)

3. What subject areas do you teach? a) all (elementary)___ b) science___ c) mathematics___
   d) social studies___ e) other (specify)_____ (9,10)

4. In what state do you work?_____ (11,12)

5. Have you ordered or received any of the energy education curriculum materials listed on the attached page?
   a) Yes___ (Go on to item 6) b) No, and I'm not interested___ c) No, but I'm interested in doing so___
   IF NO (b or c), STOP HERE. RETURN THIS FORM IN THE ENCLOSED ENVELOPE. (13)

6. Have you used the materials at all in your classes?
   a) Yes___ (Go on to item 8) b) No___ (Go to item 7) (14)

7. If you have *not* used these materials, why not? Check all that apply.
   a) Limited class time available___ b) Doubt usefulness of material___
   c) Doubt relevance to students___ d) Had no time to evaluate material___
   e) Decided to use energy education curriculum materials from another source___
   f) Feel energy education should not be part of curriculum___
   g) Other (specify)_____ (15-21)

   (STOP HERE. PLEASE RETURN THIS FORM IN THE ENCLOSED ENVELOPE.)

8. What packet(s) have you used? See the attached listing and write in the sequence number of the packet(s). _____ (22-33)

9. Approximately when did you begin using the materials? (month and year)_____ (34-37)

10. To date, how many times (i.e., with different groups of students) have you used the materials?_____ (38,39)

11. To date, how many students have been exposed to the materials? Give the approximate total since you began using the materials._____ (40-43)

12. To what extent does the material fit into the units or subject matter you are teaching? Rate the extent by circling the appropriate number. (44)
    Not at all 1 2 3 4 5 Very well

(OVER)

13. To what extent do your students find the materials interesting? Rate the extent by circling the appropriate number.

Not at all interesting 1 2 3 4 5 Very interesting (45)

14. To what extent is the content of the material related to your students' experience and background? Rate the extent by circling the appropriate number.

Not at all related 1 2 3 4 5 Very much related (46)

15. To what extent is the content of the material *relevant* to your students' information needs? Rate the extent by circling the appropriate number.

Not at all relevant 1 2 3 4 5 Very relevant (47)

16. To what extent are the topics covered in the material relevant to your geographic region? Rate the extent by circling the appropriate number.

Not at all relevant 1 2 3 4 5 Very relevant (48)

17. To what extent do students achieve the learning objectives of the materials (as stated in the packets)? Rate the extent by circling the appropriate number.

Few students generally learn the material 1 2 3 4 5 Most students generally learn the material (49)

18. To what extent have the materials had an impact on your students' awareness and understanding of the energy situation in our country? Rate the extent by circling the appropriate number.

No impact 1 2 3 4 5 Appreciable impact (50)

19. Is the *reading* level appropriate for your students?

a) Yes___ b) No, it is too high___ c) No, it is too low___ (51)

20. Is the material at the appropriate *technical* level for your students?

a) Yes___ b) No, it is too technical___ c) No, it is not technical enough___ (52)

21. Where did you learn of these energy education materials? Check all that apply.

a) Journal ads/articles___ b) National Science Teacher Association information sources___

c) Other teachers___ d) School supervisor, coordinator, principal, librarian___

e) Other (specify)_____ (53-57)

22. Apart from your own self-study of the materials, do you feel that special or additional training is *necessary* for the material to be used effectively by an instructor?

a) Yes___ b) No___ (58)

23. In your judgment, do any factors hinder the use of the materials? Check all that apply.

a) No___ b) Yes, time required___ c) Yes, space required___ d) Yes, materials/equipment required___ e) Yes, does not fit into existing subjects taught___

f) Yes, other (specify)_____ (59-64)

24. For your grade level(s) and subject area(s) taught, what additional packets should be developed or what additional topics covered to teach your students an awareness and understanding of the world of energy?_____

_____

25. For your grade level(s) and subject areas(s), should any media be added to existing materials to *more effectively* teach your students an awareness and understanding of the world of energy? Check all that apply.

a) No___ b) Yes, graphics___ c) Yes, film strips___ d) Yes, audio cassettes___

e) Yes, videotape___ f) Yes, other (specify)_____ (65-70)

26. For your grade level(s) and subject area(s), should any prescribed learning activities be added to existing materials to *more effectively* teach your students an awareness and understanding of the world of energy? Check all that apply.

a) No___ b) field trips___ c) guest speakers___ d) in-home activities___

e) student group discussions/activities___ f) individual projects___

g) other (specify)_____ (71-77)

27. In the future, it is possible that the energy education packets may no longer be provided free of charge. In your judgment, how likely would your school be to purchase the energy education materials if each packet cost $2-3?

a) Not at all likely___ b) Probably___ c) Definitely___ d) Don't know___ (78)

[1]